Mahidol University *Wisdom of the Land*

Chapter 7

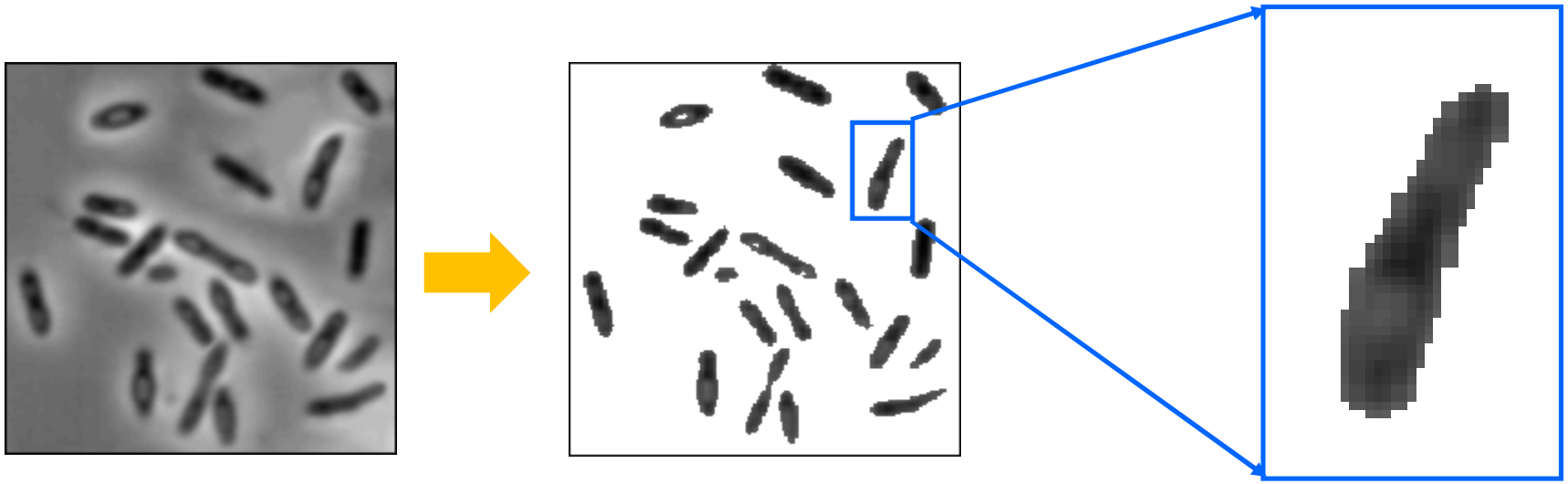
Image Segmentation

Image Segmentation

- Image segmentation is an important step in image analysis.
- Segmentation sub-divides an image into its constituent regions or object.
- The level to which the sub-division is carried depends on the problem being solved.
- That is, segmentation should stop when the objects of interest in an application have been isolated.
- The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

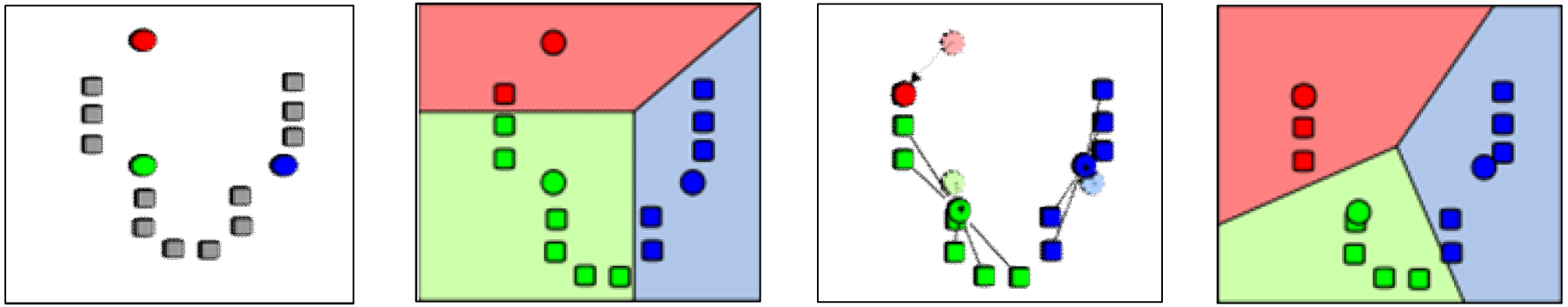
Benefit of Image Segmentation

- Image segmentation reduces huge amount of unnecessary data while retaining only importance data for image analysis.
- Image segmentation converts bitmap data into better structured data which is easier to be interpreted.



K-Means Clustering

- Image segmentation using K-means clustering is an algorithm to classify or to cluster the pixels in image into K clusters.
- For example, classify the pixels with the similar of shades in each pixel.
- The k-means approach to classify the pixels into K clusters by calculate the average of each cluster for comparison if the pixel is in cluster.



Steps of K-means algorithm

K-Means Clustering Algorithm

- Algorithmic steps for k-means clustering as follows:

  1) To classify the pixels in image into K clusters.

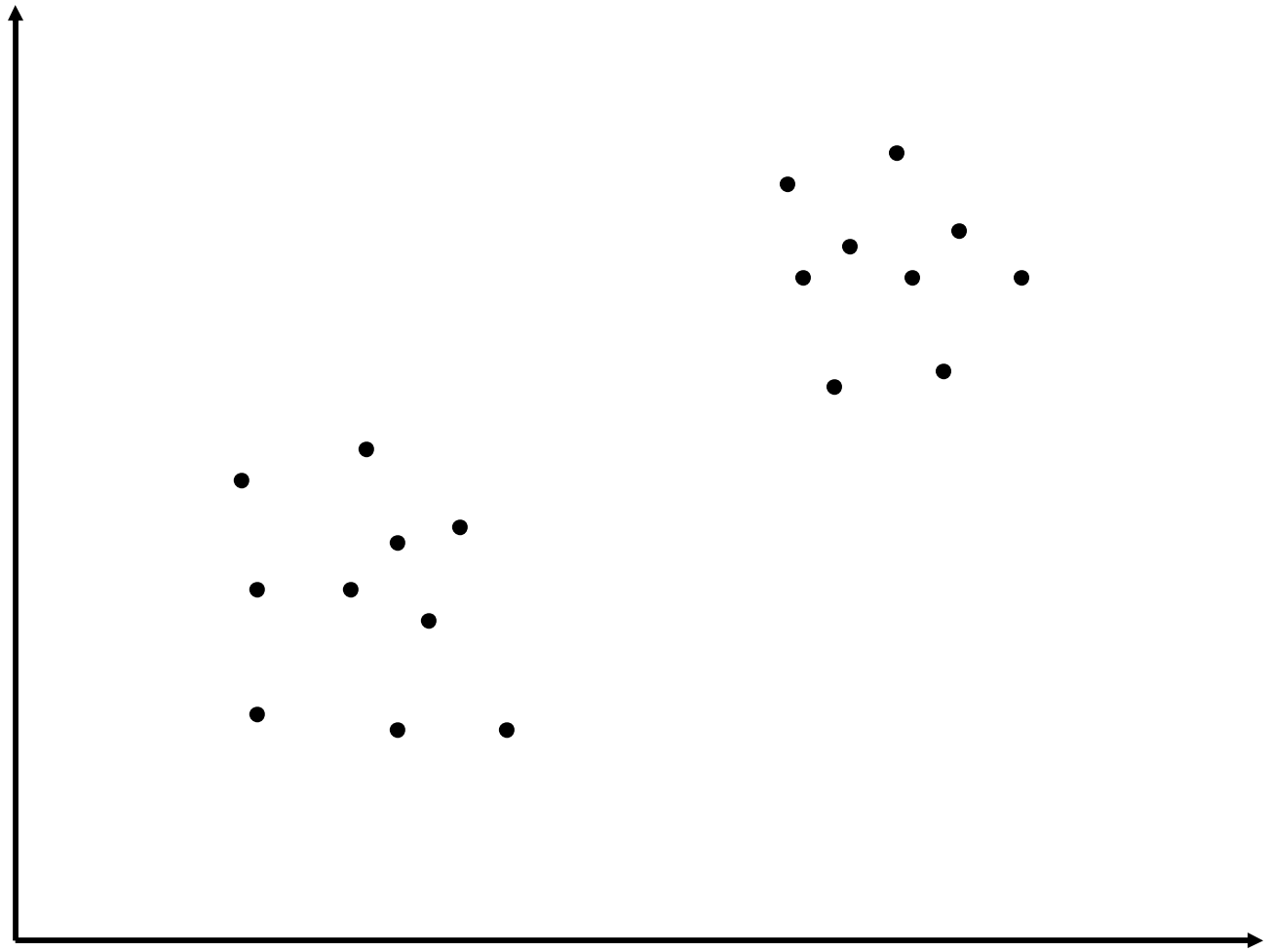
  2) Calculate average intensity of the pixel in each cluster.

  3) Compares the similar of the intensity for each pixel value in the input image with the average of the K clusters that calculated in step 2.

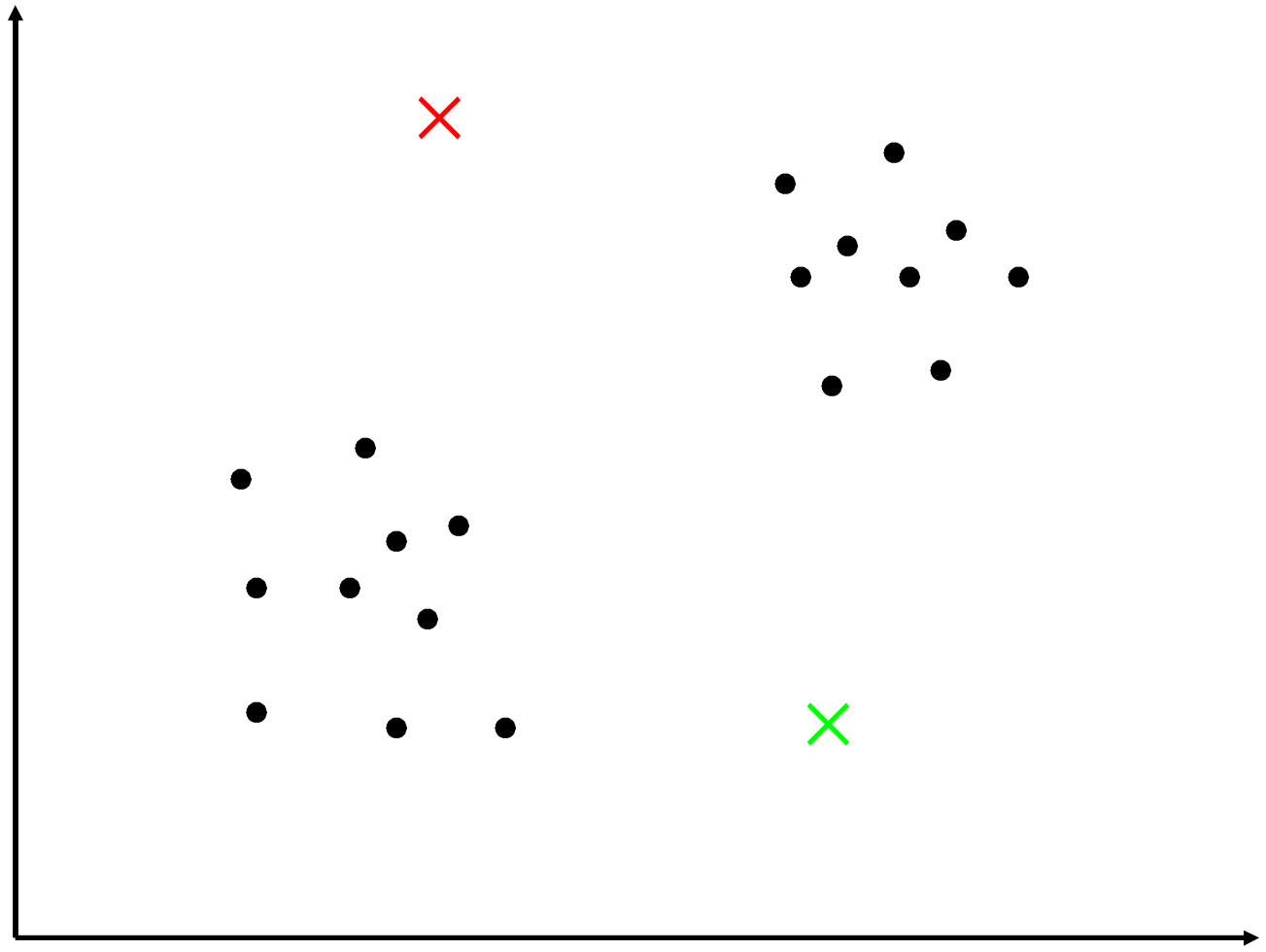
  4) If a pixel has values close to the average for their cluster to remain in the same cluster. Otherwise, the pixel is relocated to the new cluster that is closest to the average of the other clusters.

  5) Repeat steps 2, 3 and 4 until no change cluster occurred.

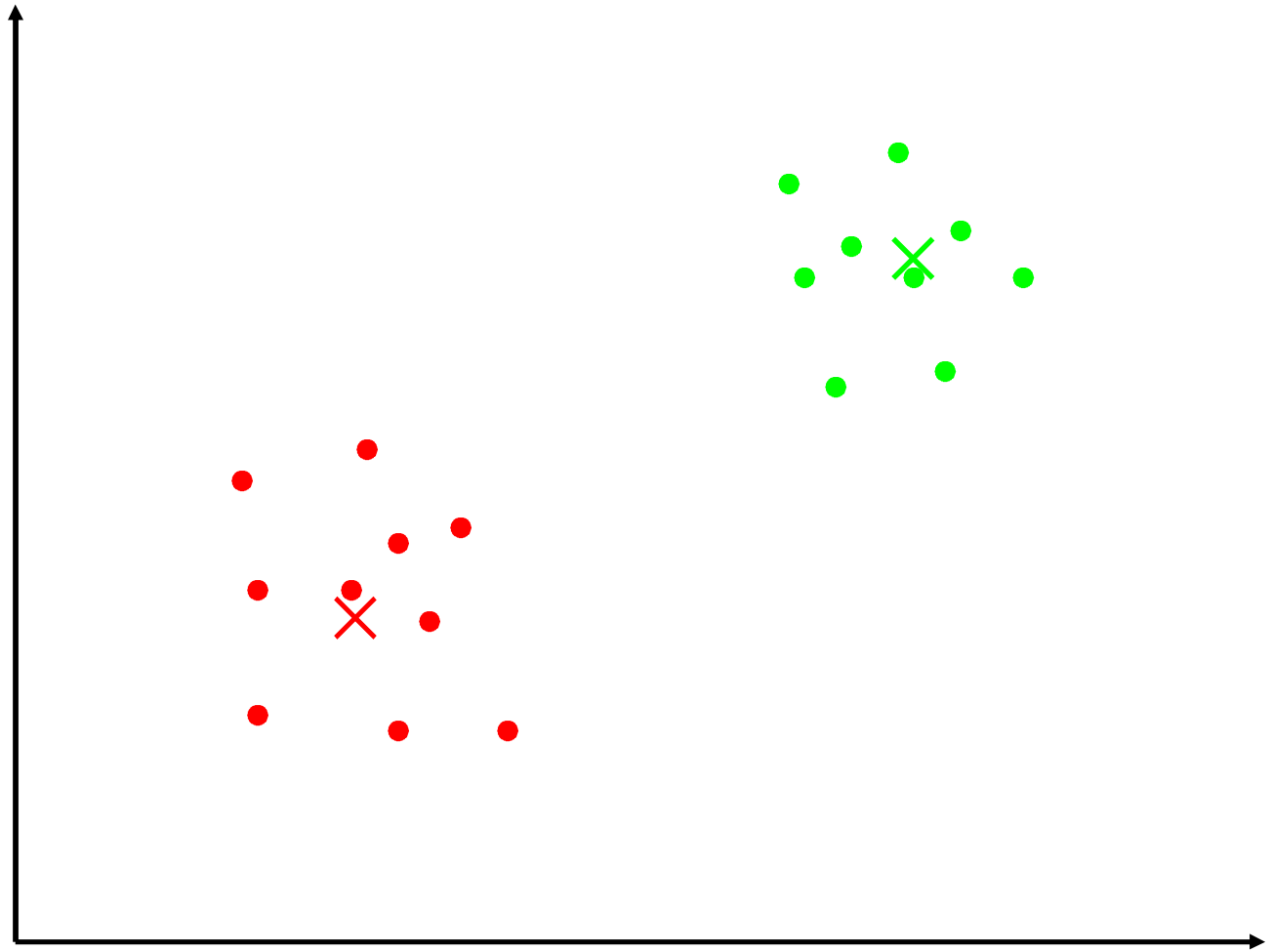
K-Means Clustering Process



K-Means Clustering Process



K-Means Clustering Process



Numerical Example of K-Means Clustering

- Consider the following input image as data set, consisting of the pixel values on each of sixteen individuals:

213	100	30	46
65	8	72	231
34	19	87	4
90	85	253	131

4x4 Input image

P1	P2	P3	P4
P5	P6	P7	P8
P9	P10	P11	P12
P13	P14	P15	P16

Label each pixel in the input image

Numerical Example of K-Means Clustering

- 1) Let the pixel values in input image are to be grouped into three clusters, k = 3.

213	100	30	46
65	8	72	231
34	19	87	4
90	85	253	131

4x4 Input image

P1	P2	P3	P4
P5	P6	P7	P8
P9	P10	P11	P12
P13	P14	P15	P16

Label each pixel in the input image

Numerical Example of K-Means Clustering

- 2) Calculate average intensity of the pixel value in each cluster.

Cluster A	Cluster B	Cluster C
P1 = 213 P2 = 100 P3 = 30 P4 = 46 P5 = 65 P6 = 8	P7 = 72 P8 = 231 P9 = 34 P10 = 19 P11 = 87	P12 = 4 P13 = 90 P14 = 85 P15 = 253 P16 = 131
Mean of cluster A = 77	Mean of cluster B = 88.6	Mean of cluster C = 112.6

Numerical Example of K-Means Clustering

- 3) Compares the similar of the intensity for each pixel value in the input image with the average of the three clusters that calculated in step 2.

Cluster A	Closest Cluster	Cluster B	Closest Cluster	Cluster C	Closest Cluster
P1 = 213	C	P7 = 72	A	P12 = 4	A
P2 = 100	C	P8 = 231	C	P13 = 90	B
P3 = 30	A	P9 = 34	A	P14 = 85	B
P4 = 46	A	P10 = 19	A	P15 = 253	C
P5 = 65	A	P11 = 87	B	P16 = 131	C
P6 = 8	A				
Mean of cluster A = 34.75		Mean of cluster B = 88.6		Mean of cluster C = 112.6	

Numerical Example of K-Means Clustering

- 4) If a pixel has values close to the average for their cluster to remain in the same cluster. Otherwise, the pixel is relocated to the new cluster that is closest to the average of the other clusters.

Cluster A	Closest Cluster	Cluster B	Closest Cluster	Cluster C	Closest Cluster
P3 = 30	A	P11 = 87	B	P1 = 213	C
P4 = 46	A	P13 = 90	B	P2 = 100	B
P5 = 65	B	P14 = 85	B	P8 = 231	C
P6 = 8	A			P15 = 253	C
P7 = 72	B			P16 = 131	B
P9 = 34	A				
P10 = 19	A				
P12 = 4	A				
Mean of cluster A = 34.75		Mean of cluster B = 87.33		Mean of cluster C = 203.6	

Numerical Example of K-Means Clustering

- 5) Repeat steps 2, 3 and 4 until no change cluster occurred.

Cluster A	Closest Cluster	Cluster B	Closest Cluster	Cluster C	Closest Cluster
P3 = 30	A	P2 = 100	B	P1 = 213	C
P4 = 46	A	P5 = 65	B	P8 = 231	C
P6 = 8	A	P7 = 72	B	P15 = 253	C
P9 = 34	A	P11 = 87	B		
P10 = 19	A	P13 = 90	B		
P12 = 4	A	P14 = 85	B		
		P16 = 131	B		
Mean of cluster A = 23.5		Mean of cluster B = 90		Mean of cluster C =232.33	

Numerical Example of K-Means Clustering

- Result of classify the pixel values by using K-Means clustering.

Cluster A	Cluster B	Cluster C
P3 = 30	P2 = 100	P1 = 213
P4 = 46	P5 = 65	P8 = 231
P6 = 8	P7 = 72	P15 = 253
P9 = 34	P11 = 87	
P10 = 19	P13 = 90	
P12 = 4	P14 = 85	
	P16 = 131	

213	100	30	46
65	8	72	231
34	19	87	4
90	85	253	131

Output image

Numerical Example of K-Means Clustering

213	100	30	46
65	8	72	231
34	19	87	4
90	85	253	131

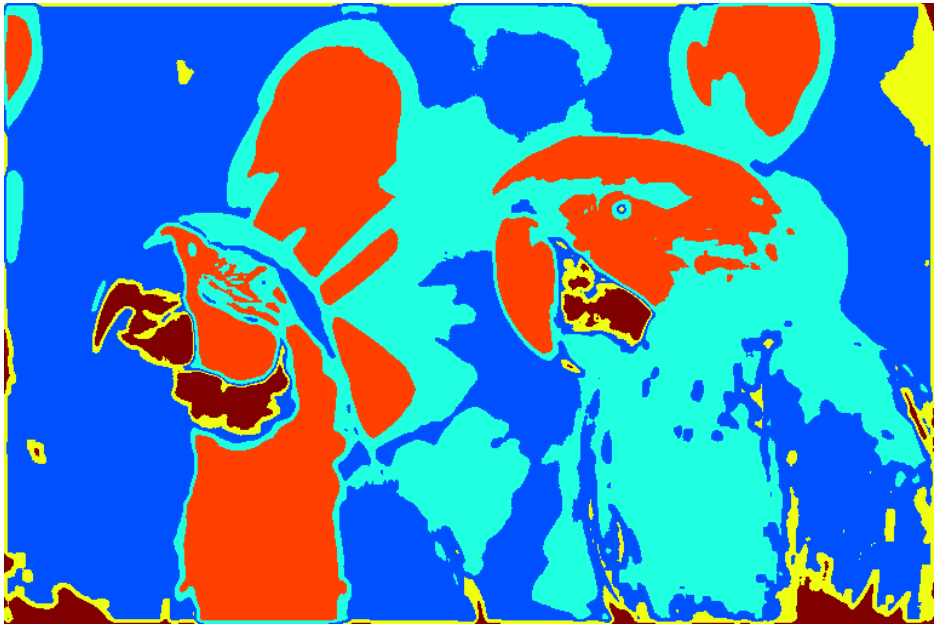
Input image

213	100	30	46
65	8	72	231
34	19	87	4
90	85	253	131

Output image

Example : K-Means Clustering

Original image



Result of image segmentation using K-means clustering (K=5)

Example : K-Means Clustering

Original image

Result of image segmentation using K-means clustering (K=4)

Example : K-Means Clustering

Original image

Result of image segmentation using K-means clustering (K=3)

Thanks for your attention